The foregoing dimensions will show the different sizes of the teeth and bones. And as the length of the tibia (minus the central process in the knee-joint) in general averages one-fourth of the height of the horse to which it belongs, in this way a fair approximation to the sizes of the animals under consideration may be obtained. It will be observed, taking the measurements of the crania from the anterior edge of the superior maxillary to the orbital cavity, that this part in the fossil is $\frac{3}{4}$ inch longer than that of the pony, and $2\frac{1}{2}$ inches shorter than the same part in the cart-horse. As this part of the horse's skull is on an average about 1 inch longer than the space from the anterior margin of the orbital cavity to over the occipital condyles, it will be apparent that, if we make a proportional allowance for this part, absent in the fossil, and of course add for the fore part of the intermaxillary bone, we shall not be far wrong in estimating the fossil skull at 2 inches longer than the pony's, and about 5 inches shorter than the skull of the cart-horse; while it will be seen that, taking the total of the antero-posterior diameter of the molars, irrespective of details, these organs in the fossil exceed those of the pony by 1 inch, and are only $\frac{1}{2}$ inch less than those of the cart-horse.

XXV.—*Some Remarks on the Succession and Development of Animal Organization on the Surface of our Globe, in the different Periods of its Existence.* By J. Van der Hoeven, Professor of Zoology, University of Leyden*.

It requires but little knowledge of organized bodies to remark that there is a great difference in their structure, and that some are more, others less complicated. This greater development depends not only on the presence of parts or organs which are absent in more simple organisms, but also on modifications in the structure of parts which exist as well in more simple as in more perfect species. In the animal kingdom, for instance, there are species which are devoid of the organs of the senses of sight and of hearing, so important in man; others which have these organs, but in a very different degree of complication. Thus the organ of hearing presents a greater number of distinct parts in mammals than in fishes; and thus, too, the eye is in general more complicated, more moveable, more nicely protected in the former than in the latter. It is needless to give a larger number of examples of this diversity of perfection. From the observation of this diversity originated a conception which seems

* Written in Dutch, in 1858, before the publication of Mr. Darwin's work. Communicated by Dr. J. Barnard Davis, F.S.A.

to have a great charm for the minds of most persons, that there is an unbroken chain of progression in all the productions of organized nature, and that there is an imperceptible transition from the one to the other, all being connected, without any jump*. It would not be difficult to refute many of the proofs which are often brought forward in favour of this connected series; but this refutation could have no other value than that of evincing that the examples were ill-chosen and delusive. It will be sufficient to remark that the existence of such an uninterrupted ladder is by no means a necessary consequence of the incontestable diversity in complication and perfection of the organisms, and that there can be degrees of perfection without an imperceptible transition from one to the other.

The conception of an uninterrupted ascending series assumes a very different character when it is connected with the opinion that there is really such an evolution from the most simple beings to the highest organisms. Many authors use the word "evolution," or development in the different divisions of the animal and vegetable kingdoms, only in a metaphorical sense; but others believe that there is really such a gradation, and that the great variety of organic bodies originates in a succession of developments. According to these authors, a more complicated organism is the descendant of another not so complicated, and this organism, again, was the offspring of a still more simple one; and in this manner, by a continuous progression from step to step, we arrive at last at unicellular forms, as the original prototypes and progenitors of the whole animal and vegetable kingdoms. In this conception the transitions ought to be altogether complete, and it seems that even the smallest chasm cannot exist. If it appears that there are, nevertheless, such chasms, it must be surmised that many living species still escape our researches, and our imperfect knowledge is the only reason of this apparent discontinuity—or that these connecting links existed formerly, but are now destroyed by some revolutions in the condition of the globe, and thus removed from our actual observation.

If we withdraw from the bright field of inquiry which is illumined by observation, and deviate into the gloomy labyrinths of opinion, it is not uncommon to behold all sorts of representations, which assume other forms and dissolve away like the confused outlines of the clouds. It is in this manner alone that we find an explanation of the arbitrary conceptions proposed by some authors, as if they were events of the history of creation. Amongst the authors who are the adherents and advocates of such an evolution of organisms as I allude to, a first place ought

* It was principally Charles Bonnet who enlarged upon this scheme, and extended the conception to the universe.

to be given to De Maillet, who lived at the end of the 17th and beginning of the 18th centuries, and was French consul in Egypt and afterwards at Palermo. His opinions are explained in a book entitled 'Telliamed, ou Entretiens d'un Philosophe Indien avec un Missionnaire François sur la Diminution de la Mer, la Formation de la Terre, l'Origine de l'Homme, etc.'*

From the supposition that animals now living and plants growing on the land all originated from organisms living in the sea, he endeavours to establish that all forms occurring among animals and plants on the continent have their representatives and corresponding species in the ocean. Birds are to be derived from flying-fishes, which, entangled by accident between the reeds, were prevented from returning to their former abode. Their fins were cloven, their rays were clothed with feathers, and the ventral fins were transformed into legs. "Il se fit encore d'autres très-petits changements dans leur figure. Le bec et le col des uns s'allongèrent, et des autres se raccourcirent. Il en fut de même au reste du corps. Cependant la conformité de la première figure subsiste dans le total, et elle est et sera toujours aisé à reconnoître" (pp. 320, 321). It is hardly necessary to say that such conceptions are inconsistent with calm and unprepossessed inquiry, and are dissipated by its touchstone.

Provided with a larger knowledge of natural history, the French naturalist Lamarck was, at the beginning of our century, the warm defender of similar views. He believed that there is a slow development, by which, from the most simple infusorium, originate different other animals, till the highest forms are attained. If all animals were confined to the same conditions, the same medium, the same temperature, and the same external circumstances, this ladder of development would be uniform and very regular. This would be the case if, for instance, there were only marine animals living at the same depth and in the same temperature. But such not being the fact, another agent steps in, in addition to that of gradation—the influence of external conditions, their relation to the wants and acts of animals, which, by constant repetition, produce habits. These habits modify the organization. Some parts, being more constantly used, increase in bulk and strength; others, by rest and inaction, lose their importance, are reduced in size, or disappear entirely. So habits form new organs, as, he says, is generally known, because it gave rise to the proverbial expression, "Les habitudes forment une nouvelle nature."† Even passions pro-

* There are various editions of this book. I have that published at Basle, 1749, in small 8vo. "Telliamed" is an anagram of the author's name.

† Philosophie Zoologique, par J. B. P. A. Lamarck. Paris, 1809. 2 vols. 8vo. See vol. i. p. 237.

duce such alterations. Lamarck thinks it very probable that fits of anger in Ruminants produce congestions in the forehead, and that, by striking each other when they fight, a greater secretion of osseous substance and a production of horny matter might be provoked, by which means they at last acquired horns*.

It would be difficult to adduce decisive proofs of facts that these and similar modifications originate in such manner. The advocates of these hypotheses point to the very limited time wherein it is allowed to man to contemplate the productions of the forming power of nature. How different would be our conception, if we were in the possession of an experience of several thousand years! Are these theories illustrated by the remains of animals which are imbedded in the many different strata of the crust of the earth? This question, at all events, deserves to be discussed.

The fossil remains of organic bodies gave occasion in former times to very different opinions. Some believed them to be only productions of a sporting Nature—mere *lusus naturæ*—remarkable representations of plants and animals, but which never were true living organisms. Others, not mistaking their true nature, believed that all these fossils were the remains of organic beings destroyed by a great flood, the deluge recorded in the book of Genesis. A further and closer examination of these remains proved, more and more, that they could not have belonged to the same period, and that there was as great a diversity between those of different strata as between these in general and the now living animal and vegetable forms. The fossil vegetable remains are chiefly stems, branches, roots, and impressions of leaves of plants; the animal fossils are bones, teeth, scales, or other hard external parts, such as shells and polyparia. After the discovery of a better distinction between the different formations belonging to the aqueous rocks (of which distinction the first attempts are due to Werner, the man who made straight the way of the geologists of our century), the persuasion became more and more fixed that in general the oldest and deepest strata contain fossils of plants and animals the most different from the now living species, and that by degrees the organic forms were modified in such a manner that the last-formed strata contain many remains of such species as do not differ substantially from those of the present time.

In a short essay on this subject it is impossible to prove this statement in detail, but the assertion is the result of all the investigations of the palæontologists of this century—Cuvier, Brongniart, Agassiz, and Owen. And the natural corollary of

* Lamarck, i. p. 256.

this theorem is that the present species of plants and animals are of a more recent date, that they are not of the same antiquity as plants and animals in general in the history of our planet. If we suppose that the now living species of organic beings lived already at the same periods to which the remains of older formations belong, then it is perfectly inexplicable why we do not find the remains of them, or at least of many of them, in all the different strata. If an antiquary finds in some old burial-places only weapons and instruments made of stone or bone, in other sepulchres only bronze implements, he is led naturally to the conclusion that these remains belong to different periods of civilization; but he would be inconsiderate and devoid of all justification if he admitted that the people in whose sepulchres he had found only stone implements were likewise in the possession of bronze weapons, which he did not find. In the same manner palæontological questions are to be discussed. When one of our contemporaries* proposed the opinion that, from the first beginning of organization upon our planet, all species of plants and animals were created at once, the now living forms as well as the others the remains of which are found in the strata of mountains, and that these various strata were formed after the creation of all these species of organic bodies, many of which died out, some in a remote, others in a more recent period,—when, I say, one of our contemporaries proposed this opinion, no antagonist arose, and the paradox passed away hardly remarked. Evidence to the contrary was too strong, and in such a case silence is preferable to the refutation of palpable error. Like silence is also better than demonstration of what is evident of itself.

It would require nearly a perfect abnegation of all knowledge gathered by observation if we did not admit these two fundamental results of palæontological investigations,—first, that there existed formerly on our planet other species of plants and animals than those which are now living; and in the second place, that the now living species of plants and animals did not exist from the beginning of life on earth. As to the last thesis, we are authorized to say with confidence that our now existing species of Mammalia did not live at the same period with the *Anoplotheria* and *Palæotheria*, the bones of which are dug up in the Tertiary formation of the neighbourhood of Paris. The fishes now swimming in European seas did not swim in the waters whose muddy deposits gave origin to the copper-slate of Maesfeldt, &c. These conclusions are the results of comparative inquiries. If the species now living existed at those periods,

* Kutorga, Einige Worte gegen die Theorie der stufenweisen Entstehung der organische Wesen auf der Erde. Bonn, 1839, S. 24.

there can be no reason given why their remains, their bones &c., were never found together with the remains of the extinct species alluded to. Perhaps the first thesis seems not so clear—that those species which we find in the strata of different aqueous rocks and deposits are truly extinct. Some may be disposed to ask whether our survey of the now living organic world is so complete that we know all the species. This is certainly not the case; but the chances of discovering species similar to those we know as yet only as fossils decrease daily, and the whole objection loses its strength because geological investigations teach us that the animals and plants of older strata are specifically different from those of recent ones. Thus not only one series of organisms is extinct, but there are several such series, the one succeeding the other. Species of the different tertiary strata are different from each other. All these are different from those of the Chalk formation; those of the Chalk formation are unlike those of the Oolitic series; others, again, are to be found in the strata of the New Red Sandstone, others in the Coal formation &c., all differing.

That some species became extinct seems in general a fact that is not so strange as that some species originated in succession—that there were consecutive and distinct creations of organic forms. Of the first fact we do not want examples, even in recent periods, within the three last centuries of history. I may refer to the well-ascertained fact of the extinction of the Dodo—a bird recorded to have been seen by several travellers, and represented in various pictures and prints. Greater still is the number of instances of local exterminations, local extinctions of species. In many civilized parts of Europe several species have now totally disappeared, which formerly were not uncommon in the same localities. At the time of Xerxes lions lived in Greece, and attacked the camels of his army*. Even a century and a half after that time, lions are mentioned by Aristotle as living in Europe†. In many parts of Europe the beaver was common in the middle ages, where it is now entirely unknown. In Wales and Scotland the bear was found in the first ten centuries of the Christian era; and even the wolf was not entirely extirpated till about the end of the 17th century‡. The extinction of species in præhistorical times, in the different geological periods which elapsed before the appearance of man, differs only in being more general—we should almost say, in being total, if the investigations of Ehrenberg did not teach us that some

* Herodot. vii. 125, 126. † Hist. Animal. viii.

‡ In 1680, when the last wolf fell by the hand of the famous Sir Ewen Cameron. (Thos. Pennant's 'British Zoology,' new ed., London, 1812, p. 88.)

microscopic species, some Infusoria and Algæ, which belong to the present creation are found likewise in very old strata, as in those of the Carboniferous or even of the Silurian group*. There are two suppositions we can make respecting the manner of the extinction of species in the history of the earth. We can ascribe that extinction to a change of external conditions, by the influence of which the life of the organisms was affected, and by whose continued action the species, formed for other conditions, diminished in number, and sooner or later perished altogether; or we can ascribe the fact to the sudden action of some violent revolutions on the globe, by which plants and animals were destroyed. The latter explanation formerly predominated; the assumption of a general cataclysm, by which the inhabited earth was destroyed, led easily and almost unavoidably to this belief. The more extended knowledge of facts showed afterwards that a deluge recorded in human history could not explain the great diversity of fossil remains which were found in the strata of mountains; and the hypothesis was modified by the assumption of several geological cataclysms, by which, during the modelling and remodelling of the earth, various generations of plants and animals perished, and were imbedded in the deposits of the water†. In our time the explanation is generally given up; but it seems that some writers go too far by an entire denial of lesser or much more sudden revolutions, which were natural consequences of the upheaving of volcanos and of chains of plutonic mountains.

That there was a succession of new species of plants and animals, a repetition of distinct creations, is, as I have already said, a conception which seems not so favourable to acceptance. There is nothing, indeed, in actual observation of the present order of nature that can be compared to this new creation. Almost daily, it is true, some formerly unknown species of plants or animals is registered in our catalogues; but there is no more reason to think that they are really new than to believe that the New World was upheaved from the ocean at a later period than Europe because its discovery was only made in the 15th century. There is, however, a power of evidence which cannot be annihilated by our doubts or by the difficulty of understanding the facts; and, in our researches on natural objects and phenomena, it is not fair to ask what we can explain before we see what we are obliged to admit by the authority of obser-

* Microgeologie. Das Erden- und Felsen-schaffende Wirken, &c. Leipzig, 1854, fol. S. xiv.

† Cuvier, for instance, speaks often of such "catastrophes et révolutions subites," in his famous and always remarkable 'Discours sur les Révolutions de la Surface du Globe.'

vation. The succession of new species of plants and animals on the surface of the earth seems to be a fact that can hardly be denied, although we cannot explain it. If we ascribe no unlimited duration to our planet, if we do not believe that it existed from eternity, we are compelled also to admit a beginning of organic bodies—an origin of life on its surface. However impossible it may be to explain the origin of organic bodies, the creation of herbs and trees, and of moving, creeping, flying, and swimming things, this difficulty of explanation affords no reason to deny that there was a beginning. Geological investigations on strata of rocks and fossil remains of a former animal and vegetable world afford proofs that our planet is older than sixty centuries; but they cannot give a demonstration that it had no beginning at all*.

To avoid the difficulty of several consecutive creations, some writers have believed that the now living organic bodies originated by changes from those species of plants and animals which we consider to be extinct. No one, however, so far as I know, has given a detailed and accurate account of the manner by which the different species which are commonly considered as extinct changed into the now living species. Even if their hypothesis were admitted, we cannot deny that many forms living in former periods have totally disappeared. In the actual condition of the animal kingdom on the surface of our globe there are only two or three species of *Nautilus*. It is impossible to think that to the production of these the large number of more than a hundred species of that genus was required—species which succeeded each other in the various periods of the history of the earth, from the Silurian to the Tertiary strata. Moreover we have the much greater number still of other multilocular shells of Cephalopods, the Ammonites, which are found in different strata, but are wanting in the Tertiary strata as well as in the existing order of nature.

If we once admit such a mutability of species, we wander into the immense field of speculation, where reasoning, or rather imagination, must fill up the gaps left by actual observation. There is a difficulty in this hypothesis which seems to have been commonly overlooked. If we consider the now living species as produced by changes from the species of former periods, much

* It is quite unnecessary to say that, in our day, a literal belief in the Bible cannot interfere with the results of astronomical or geological investigations. But whatever is stated on the chronology of the acts of creation, the investigation must, of course, end in the admission of some first origin, concerning which science cannot say anything, save the sublime and simple words of the first verse of the first book of the Bible—"In the beginning God created the heavens and the earth."

indeed among these recent forms cannot be explained without the aid of various suppositions; and, on the other hand, there is a great number of superfluous species in the existence of so many fossil forms. An unprejudiced inquiry shows evidently that some tribes or families of plants and animals were predominant in one, others in another period, and that a small number of groups, on the contrary, have been in existence in all the different periods, that they always have had their representatives in some species, and are not wanting in the recent order of nature.

There still remains, before we conclude our remarks on the history of organic bodies on the surface of our earth, one question which deserves discussion. Is it possible to deduce any general conclusions concerning the successive development of the organic world from the investigation of fossil remains, and by comparing them with each other? This question ought not to be misapprehended. We can reject indeed the hypothesis of De Maillet, who admitted that a bird was the offspring of a flying-fish, and yet believe that geology supplies us with proofs of a successive development, of an advance in the complication of organic beings. Cuvier*, for instance, admitted such a succession, although he was far from admitting such genealogies. He stated that reptiles are found considerably earlier, or in more ancient strata, than mammals, and that the more recent formations contain species which appoach nearest to those now living. Remains of Mollusca and fishes are found in the most ancient strata; reptiles form the predominant Vertebrata in the Jura and Chalk formations; and remains of mammiferous land-quadrupeds are, according to his view, only to be found in Tertiary strata. Similar remarks have been made by those writers who have devoted themselves to the investigation of fossil plants—Adolphe Brongniart, Göppert, and others: they admit that the earliest vegetation was very simple, and that there was a slow advance and manifest progress in succeeding periods towards the now living vegetable kingdom. Brongniart admits four great periods of ancient vegetation, the first ending with the Carboniferous formation†. This elder flora of our planet was chiefly formed by ferns and tree ferns. Those plants, which now constitute only one-fortieth of all the known living species, prevailed then in such a remarkable manner that they formed two-thirds of all the species which made up the flora of

* Discours sur les Révolutions, &c. See 'Recherches sur les Ossemens Fossiles,' 3e éd. 4to, Paris, 1825, i. pp. 54, 146–172.

† Histoire des Végétaux fossiles. Paris, 1828–1837, 4to. Compare also an abstract of his researches in 'Ann. des Sc. Nat.' tome xv. 1828, pp. 225–258.

the Carboniferous period. The remaining species of this flora are referred to the Lycopodiaceæ and Equisetaceæ*. The second period includes all the strata above the Coal-formation to the Upper Red Sandstone. In comparison to the first, the number of vegetable remains is only small; but, besides Acrogens, we observe amongst them Coniferous trees and Monocotyledons. In the third period, which comprehends the Oolitic and Cretaceous group, Cycadeaceæ are predominant, and next to them follow ferns, the rest consisting chiefly of Monocotyledons. The fourth period embraces the Tertiary strata. It is only in this that remains of Dicotyledons are numerous.

These results have been in part modified by new discoveries; but even now it is certain that there is a great diversity between the species and genera, and even the greater divisions of a former and later vegetable and animal world. As to these modifications in the results of palæontological inquiry, it is now proved that the opinion of Cuvier, by whom the first apparition of land-mammals was stated to have been posterior to the Chalk period, must be given up. Already, during the lifetime of Cuvier, some few remains (lower jaws) of mammals were found in the slate of Stonesfield, which was proved to belong to the lower Oolitic strata, and consequently to be of a much more ancient date than the Chalk formation, on which the Tertiary strata are resting. In the last decennium, several new examples of mammalian bones found in oolitic strata have been brought to light†; and low in the Upper Lias two molar teeth have been found, in 1847, which Plieninger refers to a mammalian genus called by him *Microlestes*.

But it seems that it would be overrating the value of these facts if we inferred from them that all great classes of the animal kingdom existed from the first beginning of life on the surface of the globe, that all were represented by different species, from the first geological periods till the modern era. In comparing the floræ and faunæ of different countries—a comparison which forms the fundamental part of a geography of plants and animals—we must look chiefly to the dominating groups, to the families and genera which are distinguished by the larger number of species. In the same manner, the characteristic features of different geological periods in relation to organic beings

* To these must be added some Coniferous trees, more allied to Araucariæ than to any of our European firs.

† In the freshwater strata of Purbeck there were discovered, in 1856 and the following years, a number of lower jaws, and even a fragment of a skull, of mammals, forming different genera, and partly allied to the insectivorous marsupial genus *Amphitherium* of Stonesfield. (See Sir Charles Lyell, Supplement to the fifth edition of a Manual of Elementary Geology, Lond. 1857, 8vo, pp. 15–27.)

must be borrowed from a numerical evaluation of natural divisions, families and groups.

In these conclusions, however, great care and circumspection will always be required, because we shall never be able, by our investigation of fossil remains, to acquire a competent knowledge of a flora or a fauna of a former period. Ten years ago, a recension of all fossil species of extinct animals and plants of the different strata was given by Prof. Bronn, of Heidelberg. He then enumerated 708 species of mammals, 148 of birds, 384 of reptiles, and 1461 of fishes as fossil. In this recension all the different strata are combined and mixed together. When we compare this general result with an evaluation of the now living species of these four classes of Vertebrata, we remark a very great difference in the relation of the numbers. The class of birds, for instance, in the present period embraces a much greater number (perhaps 5 or 6 : 1) than that of mammals. In the combined faunæ of former periods the relation between the species of birds and mammals would be, on the contrary, like 1 : 5. But still greater would be the difference in the comparative numbers of species in the lower classes. Prof. Bronn assumes 2885 species of fossil Articulata, 13,805 of Mollusca, and 4895 of Zoophytes (chiefly Echinoderms and Polypes). In the present condition of the organic world, the number of known species of articulated animals is much greater than that of the Mollusca—nay, even than that of all the other classes put together. The class of Insects (now so greatly predominant that several orders contain myriads of species) is represented in Bronn's list by only 1551 species*. Even when we grant that the relation between the numeric value of species belonging to each class was different at former periods (and this cannot be denied), we must still have recourse to other reasons for the explanation of these facts. We must search for another solution of the question why birds amongst the Vertebrata, insects amongst the lower animals, have left such a small number of remains in comparison with those of fishes and mollusks. Moreover, of the fossil remains of insects, nearly all belong to Tertiary periods; Tertiary species of insects form fourteen-fifteenths of the whole number. It would be an inconsiderate and highly uncritical conclusion, if we were led by this evaluation to the belief that the number of insects was so small in former periods, because we see so few remains of them in the strata of our rocks. It is also clear that the vestiges of Medusæ and other soft animals, which are so numerous in our seas, may be totally wanting,

* Leonhard und Bronn, 'Neues Jahrbuch für Mineralogie,' 1849, S. 128; H. Bronn, 'Handbuch der Geschichte der Natur,' IIIter Band. Stuttgart, 1849.

without giving a right to deduce from that negative evidence any conclusion as to the absence of those animals.

From the foregoing remarks it follows that our knowledge of the former species of organic beings is imperfect, and that it will ever be so, even when it is enlarged and newly remodelled by the most splendid future discoveries. General comparisons must thus be restrained to some classes and groups. Such are, in the animal kingdom, the reptiles, fishes, and the mollusks (chiefly the Cephalopods, the Conchifera, and the Brachiopods), the Echinodermata, and the Corals. A comparison in such a limited direction will certainly give some interesting results. A fundamental point for these investigations has already been gained in the conclusion, deduced from a great number of facts, that the different formations are characterized by their respective fossils*, which, indeed, is but another formula for the statement that the various species have a distinct term of duration, and that their existence ended sooner or later. It will also be seen that the oldest strata contain remains chiefly of non-vertebrate animals, that only in later strata a greater number of Vertebrata appear, and that in the strata which embrace the Lower New Red Sandstone, up to the Chalk, reptiles (chiefly *Sauria*) are predominant. It is first in Tertiary strata that the remains of Mammalia become numerous, of which class, as we have already said, remains are indeed not entirely absent in older strata, but are in that case in a subordinate proportion to the remains of reptiles†.

* The late Prof. Jameson remarks that Werner, his master, already made the observation that "different formations can be discriminated by the petrifactions they contain, that petrifactions appear first in transition rocks, that these are but few in number and of animals of the zoophytic or testaceous classes. In the older floetz rocks they are of more perfect species, as of fish or amphibious animals; and in the newest floetz and alluvial rocks, of birds and quadrupeds, or animals of the most perfect kind." See his notes following his translation of the 'Discours' of Cuvier, 'Essay on the Theory of the Earth,' 3rd ed. Edinb. 1817, pp. 232, 233. But already, long before Werner, as is stated by Humboldt (Essai géognostique sur le Gisement des Roches, Paris et Strasbourg, 1826, 8vo, p. 37), the first point —that different formations can be distinguished by their fossils—was acknowledged by Lister in reference to fossil shells. It is this peculiarity which gave occasion to the so-named *Coquilles caractéristiques* of French authors, or *Zeitmuscheln*, as they are named by the German geologists, which were duly appreciated by the great Leopold von Buch in several of his latest papers.

† These general remarks on the succession of animal life at the surface of our globe were proposed, in 1841, by the eminent palæontologist, L. Agassiz, in his address at the inauguration of the University of Neufchatel, 'De la Succession et du Développement des Êtres organisés à la surface du Globe terrestre dans les différents âges de la Nature' (Neuchatel, 1841, 8vo). In this work we have the periods, (1) of Fishes, (2) of Reptiles, and (3) of Birds.

But how probable soever such a successive change and advance in perfection may be, the geological facts cannot be adduced, without alteration and interpolation, as confirming the doctrine of a continuous change of beings, such as would be required to establish a development by which more complicated forms are the offspring of more simple prototypes. Such a view would require another distribution of fossils in the succeeding strata—so that, for instance, fossil Cephalopods should be the latest of all mollusks, and not, as they really are, already represented in the oldest fossiliferous rocks. If the species have changed by degrees, we should expect to find traces of this gradual modification. If one form gave birth to another, why should we not find some fossils between mollusks, or insects, and Vertebrata? Such a discovery has never been made.

It is plain, if we are sincere and unbiassed observers, that geological facts give no support to those hypotheses we have been treating of, and that they rather militate against such theories, which cannot deserve the name of *natural* theories at all. Creation, the first origin of things, is, and perhaps always will be, a mystery; the mystery is by no means elucidated if we assume germs. The first animal, for instance, that possessed organs of vision has to be derived from another without eyes. But why should such a supposition seem clearer and more intelligible than the creation of an entire animal provided with eyes? Here science does not shut her books, as it has been said by some: true science never opened books on such questions.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

Dec. 8, 1863.—E. W. H. Holdsworth, Esq., F.Z.S., in the Chair.

On the Breeding of the Green Sandpiper (Helodromas ochropus). By Alfred Newton, M.A., F.L.S., F.Z.S.

Ornithologists are aware of the very different positions often chosen for their nests by birds of the same species. Thus Eagles may be found sometimes building their eyries upon trees, at others on cliffs, and again sometimes absolutely upon the flat ground. The same may be said of some species of Falcons and of some Herons. Certain Crows also and the Stock-Dove (*Columba Œnas*) exhibit a like disparity of habit. Even among the members of the Gallinaceous order a similar diversity is occasionally, though rarely, to be observed. I have been told, on authority I cannot question, of a common Pheasant (*Phasianus colchicus*) and of a Capercally (*Tetrao Urogallus*) each choosing a nest in a tree wherein to lay its eggs. Instances of the common Wild Duck (*Anas Boschas*) breeding in hollow stumps